

**ENGINEERING DEVELOPMENT OF
CERAMIC MEMBRANE REACTOR SYSTEM
CONVERTING NATURAL GAS TO
HYDROGEN AND SYNTHESIS GAS FOR
LIQUID TRANSPORTION FUELS**

Monthly Status Report Period Ending: 06/31/1998

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June 1998

Contract Objectives

The objective of this contract is to research, develop and demonstrate a novel ceramic membrane reactor system for the low-cost conversion of natural gas to synthesis gas and hydrogen for liquid transportation fuels: the ITM Syngas process. Through an eight-year, three-phase program, the technology will be developed and scaled up to obtain the technical, engineering, operating and economic data necessary for the final step to full commercialization of the Gas-to-Liquids (GTL) conversion technology.

Summary of Activity

Task 1.1 Process Design and Engineering

Task 1.1.1 Process Design and Engineering

A meeting was held at Chevron to review the process design work carried out by Air Products, and a timetable was established for the completion of this task.

Task 1.2 Materials and Seals Development

Task 1.2.1 Materials Development

The development of additional brownmillerite compositions with improved physical properties continued through joint efforts by Ceramatec and Air Products. Ceramatec synthesized additional compositions for oxygen permeation testing at Air Products. Various glass and braze ceramic/ceramic seals were investigated to minimize seal reactivity and porosity for the atmospheric screening tests of these new compositions.

Subtask 1.2.1.1 Materials Characterization and Assessment

At Eltron Research, construction of the six atmospheric pressure, quartz test reactors continued, with completion expected in July.

Subtask 1.2.1.2 Powder Production and Test Sample Fabrication

Ceramatec began the isopressing of tubes for test samples using a batched addition of binders to the powder. After modification of the pressing equipment, closed-ended tubes were successfully pressed and fired, and were He leak tight after sintering.

Subtask 1.2.1.3 Low DP (< 300 psig) Testing

Construction of the hot-wall, 300-psig test reactors continued at Eltron. The high-pressure vessels are now expected to be completed in July. An outside company began programming of the programmable logic controller. The estimated date for completion of the test reactors is the end of August.

Subtask 1.2.1.4 High DP (< 500 psig) Testing

Construction of the high-pressure reactor continued at Air Products. Enclosures have been constructed, and conduits have been installed for the gas supply piping, electrical, digital and sensor services. Air Products also fabricated gas handling systems and contacted potential vendors for the cold-wall pressure vessel.

Task 1.2.2 Seals Development

Components of the ceramic/metal seals were ordered. Preparation of tubes for seal assemble is anticipated in July.

Task 1.3 ITM Syngas Reactor Design and Fabrication

Task 1.3.1 ITM Syngas Reactor Design and Engineering

Subtask 1.3.1.2 Reaction Engineering and Kinetic Modeling

A meeting was held at Chevron to review the reaction engineering and kinetic modeling program, and a timetable was established for the completion of this task.

Task 1.3.2 ITM Syngas Membrane Fabrication

Subtask 1.3.2.1 Powder Production, Process Development and Scaleup

Work continued at Ceramatec on scaling up the first of two powder compositions selected for powder production development. Approximately 30 kg of the composition were in various stages of processing, and preliminary spray drying tests have been run. Ceramatec investigated methods to control the viscosity and pH of the aqueous slurries for spray drying.